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ABSTRACT

The potential use of interactive videodiscs for teaching foreign languages, and factors to be considered in evaluating such programs, are discussed. Two types of existing programs, developed and used at Brigham Young University, are described: adaptations of existing video material, such as the classic Mexican film "Macario," and free branching simulations of real life situations, such as the videodisc "Montevidisco." Evaluation of videodisc programs must consider three kinds of empirical activities: (1) development, content and presentation of the videodisc itself (formative evaluation); (2) learning outcomes produced (summative evaluation); and (3) interaction of the technology with student control of the learning. Furthermore, evaluation of student learning from the videodisc programs must consider both system-generated data (e.g. length of session, choices made by student, responses to questions, etc.) and non-system generated data (contextual variables, students' self-reports, and students' ability). Although there is little evaluative data on videodisc instruction, data from two studies are presented: outcomes of the college-level "Macario" program, and high school Spanish. In both studies, the students using the videodisc instruction did significantly better on posttests of content and listening comprehension than students in traditional programs. Finally, questions and issues to be considered in future evaluations of videodisc instruction are discussed. (JGL)

Evaluating the Use and Effectiveness of Learner Controlled, Interactive Videodisc

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Running head: EVALUATING INTERACTIVE VIDEODISC

Abstract

The need for evaluating interactive videodisc instruction is outlined and three roles for empirical activities in developing videodisc instruction are discussed. Next, two classes of data available for evaluating videodisc instruction are identified with a discussion of how those data might be used to meet issues in developing interactive videodisc instruction. Finally, issues that remain to be explored in evaluating videodisc instruction are raised and the practical potential of interactive videodisc as a mode of instruction is explored.

Evaluating the Use and Effectiveness of Learner Controlled, Interactive Videodisc

As the technology for delivering instruction changes, evaluation methods need to be adapted to fit the special needs of the new technology. In this paper we discuss possible roles, methods and issues for evaluation in the development of interactive video instruction. First, to provide a context for the comments on evaluation, two different types of interactive videodisc instructional programs are reviewed.

Two Types of Videodisc Instruction

The authors are responsible for implementing an ongoing evaluation system as part of the development and use of interactive videodisc programs produced at Brigham Young University. In the last six years, developers at the University have designed and produced six separate interactive videodisc instructional packages for use in second-language acquisition. In doing this the developers have used one of two approaches: adaptation of existing video material, or production of free branching simulations.

Adaptations

The first approach uses existing programs or instruction from film or video tape and a microcomputer based adaptation template. The resulting language instruction usually retains much of the linear nature of the original material, however it provides several new instructional features. Students can easily stop the presentation to make notes or take a moment longer to translate a difficult phrase. They can repeat any segment of the program, request a translation of the dialogue in a second language (recorded on sound track two of the disc), and stop the disc to ask the system for information

on key elements or themes in the presentation. These interactive videodiscs are intended to expand the students' vocabulary, sensitize them to cultural details, and shift instructional control to the students so they will be more actively involved in their own learning. One example of the adaptation process is a videodisc based on the film "Macario".

"Macario" is a classic Mexican film used by Spanish instructors to teach analogy, symbolism, and higher levels of cultural understanding as well as listening comprehension. In collaboration with the Spanish faculty at Brigham Young University, selected motion segments and still frames from the film were identified for transfer to videodisc. A computer program was written which allowed students to stop the disc at will, ask for various forms of elaboration or help, and then return to viewing the film. After viewing a scene in Spanish, students had the option of hearing it repeated in English. It was expected that students would view the program several times, exploring different aspects of the film and gain increased listening comprehension.

Simulations

In addition to adapting existing films, the random access capacity of the videodisc makes this technology very useful for free branching simulations. Language instruction using this second approach to interactive videodiscs contains drama and dialogue which simulate real-life interactions with natives in another country. These programs are intended to help students improve their vocabulary, listening comprehension and speaking ability, as well as familiarize students with another culture. One example of such a simulation is a videodisc entitled "Montevidisco."

Students proceed through a fictitious Mexican town, Montevidisco, by

making choices in response to situations presented. At each scene, students see and hear an actor or actress talking and asking them questions in Spanish. Students respond to each scene in two ways: by pressing a button to select an option from a menu of answers presented in English on the screen, and by speaking that same answer in Spanish into a tape recorder for later analysis by the student and instructor. Students also have the option of asking for a surrogate to appear on the screen and correctly repeat their selected answer in Spanish. After making these responses, the program branches to the next scene which corresponds to the choice made in the previous scene. Depending on the choice made, students can "visit" many different parts of the town and meet a variety of townspeople in realistic settings.

Need for Evaluating Videodisc

The potential power of interactive videodisc as a learning tool in a variety of contexts has raised considerable interest among educators world-wide (Putnam, 1983; Schneider & Bennion, 1981). Within the last few years, many research projects and several publishing and software companies have been created to produce interactive videodisc programs. At least four new newsletters or journals have been initiated by this interest. Unfortunately little evaluation of instructional programs using the technology has been done. Likewise, research is lacking on how to optimally use the technological and instructional features of videodisc. Given the precarious position of most innovative instructional practices, it is clear that research and evaluation should be an important part of any videodisc development effort. To meet the needs of interactive videodisc production, three types of empirical activities are needed.

The first empirical activity needed is formative evaluation of individual

videodisc programs. In any development effort there is the risk of unclear instructions, presenting ideas in an illogical order, using undefined terms, and a host of other problems. In developing instruction for a new medium such as interactive videodisc the problems are multiplied by our relatively limited experience with the medium and the greater number of design variables that can be manipulated. Furthermore, since the present videodisc technology makes it extremely difficult if not impossible to change the videodisc image or sound track once the disc is mastered, it is imperative that weaknesses in the instructional system be corrected early in the development process.

Secondly, summative evaluation is needed. The expected outcomes of interactive videodisc instruction are often different than language instruction presented by more traditional media. Not only are students expected to develop vocabulary, listening skills, speaking fluency and cultural awareness, but they are expected to gain skills in self diagnosis and management of instruction. The opportunity for choice in instruction presumes the ability and willingness to chose well. Therefore, in addition to formative evaluation to improve instruction, experiments comparing outcomes for students taught through videodisc versus other methods must be conducted.

Thirdly, research on how the technology and instructional features of videodiscs interact with student control and relate to outcomes is needed. In summarizing learning research from several disciplines, Fleming and Levie (1978) identified variables that influence how well instruction communicates, trains and persuades learners. Instructional designers now have greater control over these variables through the capabilities of interactive videodisc and can manipulate them in ways that were before only dreamed of. A wide

range of practice and testing opportunities present themselves through the medium of interactive videodisc. How should these opportunities be used? Can they be orchestrated to help students both acquire and integrate intellectual skills (Olsen, 1983)? How might these capabilities be used to make the content more transparent to the learner so that more important problem solving skills can be developed (Brown & Williams, 1983; Salomon, 1979)?

The overriding perspective the authors have in suggesting these empirical activities is the need to embed evaluation and research activities systematically into the videodisc development process. Data needed to conduct these empirical activities and the analytical techniques for examining the data are discussed next.

Data for Evaluating Videodisc

There are two major classes of data potentially available for studying interactive videodisc instruction: system-generated and non-system generated. Both are critical to the evaluation and research activities identified earlier.

System-Generated Data

Because the instructional system includes a microcomputer, it is possible to create a data file for each instructional session that includes detailed information about the stimulus being presented to the student and the responses made. This data file can include information such as the following:

1. Student identification name or number.
2. Time and date of session.
3. Duration of session.
4. Student interaction with stimulus and choices made by students, including:

(a) Scenes presented in the sequence viewed.

(b) Total time spent on each scene (including interrupts and repeated viewing).

(c) Points at which the student interrupts the scene.

(d) Choices made at each interrupt, in the sequence that they are made.

(e) Latency between the presentation of choices and the selection of options.

5. Responses to inserted questions regarding student attributes (demographics, prior learning experiences, attitudes, cognitive ability, etc).

6. Student comments on the lesson (a text file referenced to the instruction presented that the student can create in order to comment on the experience with the system).

7. Summed variables for selected events (number of interrupts, questions attempted, number of times repeating each scene etc.).

The case level stimulus-response data just described presents a rich but potentially overwhelming amount of information. The effective use of this data depends upon synthesizing it into a comprehensible array.

Three general strategies exist for summarizing or synthesizing this data: frequency counts by event (e.g., number of interrupts per scene), the duration of certain events (e.g., time to answer a question measuring comprehension), or sequential patterns of events (e.g., reviewing a scene before attempting a test question versus reviewing only if the test question is missed). The summarized data can then be more readily understood and related to other variables such as outcomes or student characteristics. The analytical techniques

appropriate for frequency and duration data are widely understood; analytical techniques to identify sequential patterns are less available but some applicable techniques have been developed for understanding complex observation systems (Wadham & Hansen, 1982).

It can be seen that using a microcomputer for delivering instruction opens up an extensive array of information for studying videodisc systems. However, the full usefulness of that data for examining evaluation and research issues cannot be realized without combining it with data from non-system generated sources.

Non-System Generated Data

Of course there are data on many variables of importance that cannot be gathered by the system itself. Three areas of study that require non-system generated data are presented below.

Contextual variables such as noise, the presence and activities of other people, students' verbal and non-verbal behavior between key presses, etc., should be gathered by observation of the instruction in use (Sanders, 1983). This data gives a basis for evaluating the validity of other information collected about the instruction. Such data might be collected by live observers or by video tape for later analysis. The observation procedure could well use a computerized event recorder (Wadham & Hansen, 1982) to aid observers in documenting on a time-based record their observations of a large number of phenomena.

Students' self-report of demographic variables and perceptions of their own affective reactions may be gathered by the system, but in most cases this would be gathered by written questionnaires or interviews.

Students' abilities are often assessed through written exams and through skill-assessing performance measures. In the final analysis it is the student's performance in real settings that matters, and therefore, by definition non-system generated data need to be gathered to validate the benefits of interactive videodisc instruction.

Combined with the system-generated data, a vast body of information is potentially available to the developers, the sponsoring agencies and users of the system for addressing a variety of evaluation issues. The question is, given this complex data set, what specific issues should be addressed?

How to Use the Data

As discussed earlier, three types of empirical activities are needed to enhance the quality of interactive videodisc instruction: formative evaluation, summative evaluation and research on the instructional attributes of the medium. In this section is discussed how system-generated and other data may be used for each of these activities.

Formative Evaluation

At the present early stages of product development we have focused primarily in our work on identifying the kinds of interaction students have with the instructional material and then comparing these interactions with assumptions about how students should interact with the material. For example, we have assumed that instruction will be most effective if the students feel that they are comfortably in control of the presentation of instruction; that is, they understand the options before them and these options provide meaningful forms of control over the instruction. If in interviews with the students we find this is not the case, then efforts are made to revise the materials.

Another example of using descriptive information in conjunction with assumptions about good instruction involves the choices students make when presented with a list of options. For a menu of options to be useful, at least some students should select each of the options presented. If in examining the interaction of a large number of students with the system we found some options not being selected, the value of those options, or the clarity of those options would be drawn into question.

The formative evaluation activities to generate this information can include both the use of mock-ups of proposed instructional units and revisions in computer programs and computer generated visuals after the production of a disc. The mock-ups can take several forms at different stages of development. In very early stages it may be as simple as having the developer take the role of the interactive system and talk through the instruction in response to student questions.

In later stages of development it is possible to use artists rendering of key visuals or even the rough-cuts of the final video productions to produce mock-ups. Recording these visuals on a random access videotape player (which the developer or evaluator will still have to control manually in response to student choices) can greatly enhance the fidelity of the students' experience. Information is gathered by observing the choices students make, having them think out loud as they try to understand the instruction and react to the experience, and by interviewing them after they complete the instruction. Not only can you find out if students are able to follow the instructions and understand the concepts presented, but you can find out to an important degree whether they care about what they are learning and can relate it

to other things they have learned.

Formative evaluation can still continue after the disc is produced. The computer program which controls the instruction can be modified (assuming that it is recorded separately from the disc) and to a limited degree so can the video material which is recorded on the disc. Computer generated text can be changed to give different options or present explanations to clear up confusing material on the disc. In some cases it may be possible to resequence the presentation of material from the disc or substitute equivalent segments of the disc to make up for deficient visuals. It may even be possible to substitute computer generated graphics for deficient visuals or to superimpose graphics over a disc image to mask or repair bad spots on a visual, depending on the capability of the authoring and delivery system.

In evaluating produced discs the type of study moves from single subject uses of the system to larger group try out. For this type of formative evaluation setting, system-generated data and other data is invaluable for identifying problems. Clearly, given an instructor who knows how to use the microcomputer authoring system and who is interested and able to use the analysis capabilities of the data feedback system, the formative evaluation and revision of interactive videodisc can continue long after the system is in use. This potential for updating the instruction is important to extend the value of a given instructional package.

Summative Evaluation

Given the potential for using formative feedback to change the instruction presented, it may be argued by some that it is not very meaningful to conduct summative evaluations of interactive videodisc systems. If the system is

being continually changed, which version of the system is the one that should be evaluated? While there is some merit to this argument, it still remains that sponsoring agencies and consumers have a need to know what the benefits are of using an implemented system.

Information about student outcomes as effected by videodisc instruction is essential in justifying the expense of developing instruction in the new technology. Some summative evaluation has been done of videodisc instruction with encouraging results.

Macario outcome study. In a recent exploratory study employing intact groups, intermediate level college students using the "Macario" program spent an average of 158 minutes studying the videodisc individually. A control group of students received a 50-minute lecture on what to look for in the film, then were invited to see the film straight through individually as many times as they wanted. They spent an average of 101 minutes viewing the film for a total of 151 minutes average instruction time. Another control group individually viewed the film as many times as they wanted but did not receive instruction on what to look for in the film. This third group spent an average instruction time of 130 minutes.

For all three groups outcome was measured with a 100 item multiple-choice test covering the concepts in "Macario" as identified by the students' instructor. Differences between the groups on pre-treatment Spanish grammar scores, number of years speaking Spanish, years lived in a Spanish-speaking country, Spanish GPA, total college GPA, and year in school were not statistically significant at the .05. These non-significant differences indicate that the groups were equivalent on a number of attributes prior to instruction.

However, when the instructional outcome measure was examined for the three groups, the treatment group out performed the combined control groups by more than one standard deviation on the exam of concepts presented in the film, $F(2, 53) = 6.29$, $p < .01$. The two control groups were not significantly different from each other on the outcome test.

High school Spanish study. In a second study involving high school students and videodisc technology for Spanish instruction, the instructional advantages of videodisc were again demonstrated. Existing footage produced by the BBC to teach beginning Spanish was transferred, with permission, to videodisc and adapted for use in a classroom setting. Two classes of high school Spanish students were randomly assigned to one of three treatments: Personalized, interactive video (PIV) in which students worked individually at a computer work station to receive instruction; Classroom, interactive video (CIV) in which the class as a group would view the program with the teacher controlling the program to respond to student questions, etc.; and, a traditional approach to Spanish instruction (Traditional) covering the same content as in the video (vocabulary, phrases, grammar) but through the use of printed materials and classroom drills. Students in each treatment received five, 54 minute instructional sessions.

Pretest measures were collected for students in the groups on age, sex, GPA, and scores on the Spanish MLA test. No significant pretest group differences were found on these measures.

At the end of the instruction all of the participating students were post-tested with a Spanish listening comprehension exam. Both the PIV and the CIV groups scored higher on the outcome test that the Traditional group,

$F(2,44) = 14.662$, $p < .001$. Furthermore, the PIV group was significantly higher than the CIV group. The differences were instructionally meaningful, with the mean of the PIV group being 1.76 standard deviations above the Traditional group and .45 standard deviations above the CIV group. The CIV group mean was 1.11 standard deviations above the Traditional group mean on the listening comprehension test.

These findings suggest that interactive video is substantially more effective when compared to traditional lecture, dialogue and classroom practice. And, although individualized instruction was most effective, when costs and facilities are considered, group use of interactive video may be equally or more attractive as an instructional option.

Research

The research on interactive video should include a molar, holistic view; taking into account the capabilities of the technology, the nature of the content and its instructional design. This research should examine how the technology is integrated (or not) into existing instructional systems. This section discusses the stimulus potential of interactive video for research. It also identifies questions relative to cognitive and attitude change that might be researched.

As mentioned earlier, the breadth of presentation strategies available to us through interactive video is extensive. As can be seen in Figure 1, there can be as many as 76 presentation types available in videodisc. When these elements are organized in different sequences, a myriad of possible instructional strategies result. The variety of presentation types and instructional strategies available in interactive videodisc makes it possible to control instruction

and therefore answer many research and evaluation questions which, in the past, were not readily available to us.

Insert Figure 1 about here

The technology is so new and its potential so broad that most educators have yet to imagine how that potential might be employed in researching important questions. Even new authoring systems expressly developed for CAI/interactive video instruction only permit the use of a very limited subset of the 76 presentation types available.

In formulating a research agenda, however, the technology should not dictate the research questions. We must take the time to learn from the technology what it can deliver, what its capabilities really are. Our vantage point should be the questions related to how learners pay attention to messages and process, retain and transfer both knowledge and skills to new situations (Gale, 1984).

In researching the effectiveness of interactive video presentation capabilities, it should be remembered that research has identified several different types of human learning (Gagne, 1977), each of which requires that different elements be present and that different conditions be satisfied. Important questions could be asked regarding the use of interactive video in supplying the elements and satisfying the conditions of each learning type.

Research on interactive video instruction should investigate the position of Salomon (1979) who contends that how instruction is presented determines what intellectual skills are developed by students. His research suggests

that both intellectual skills and content can be acquired at the same time with apparently no extra effort on the part of the students, the intellectual skills being learned informally. How interactive video can be used to test Salomon's ideas and how its capabilities might be employed to assist students' developing desired intellectual skills are key questions.

A related set of questions has been raised by Gagne (Olsen, 1983) as he has contemplated the use of interactive video. Gagne posits that interactive video holds out promise for teaching separate intellectual skills, for helping students to combine intellectual skills (he calls this "composition"), and for providing the kind and intensity of practice that such skills will be used automatically ("automaticity"). Research questions important in this area include:

1. What effect does continued practice of an intellectual skill have upon retention of that skill?

2. Can we demonstrate that continued practice of an intellectual skill leads to composition--the combining and short-circuiting of steps in the procedure?

3. Does continued practice lead to a speeding up of the performance of the procedure?

4. How much and what kind of practice does it take to produce automaticity in an intellectual skill?

Still other questions ought to be based on the more recent findings of psychologists that suggest that certain skills, among them language acquisition, are acquired more readily when the details of the content being taught are relatively transparent to the learner (Brown & Williams, 1983). As an example, when a student of language is expected to pay close attention to syntax,

grammar and the definitions of words, the meaning of a phrase or paragraph can be lost or obscured. Can language, then, be learned more quickly or more effectively through the intensive and personal use of interactive videodiscs in the target language? Can the immediacy and apparent reality of the presentation have the same effect as a total immersion approach? How might the technology be used to take advantage of the ability of people to process huge amounts of information informally thereby making the language learning tasks more transparent?

Because of its immediate, potentially personal and realistic nature, interactive video might become a powerful tool for encouraging the acquisition of desirable attitudes (Gale, 1983). Questions could be investigated relative to what makes a model appealing and credible? How clearly is the model's actions communicated to the student are the actions seen as desirable? What makes a model appear to be similar to the student. Other questions related to attitude acquisition could also be asked beneficially through the use of interactive video.

Pending Evaluation Issues

In examining the challenges of using and studying interactive videodisc instruction it is important to remember the lessons of past instructional innovations. Furthermore, the task of evaluating and researching videodisc instruction requires that a number of questions be answered. Our experience allows us to raise many but answer few of these issues.

Repeating History

In using this technology to evaluate and research learning approaches, learning theory or new presentation strategies, we should be careful to not repeat past errors. During the 1960's the technological rage was instructional

television and everyone had to have televisions installed in classrooms, with many demanding that TV production facilities be provided at their institution. It was as though the technology itself provided the instruction.

What was overlooked by too many was the simple fact that the technology, in this case television, was the carrier of a message, and that both the technology and its messages had to be considered as an integrated whole. Research of this era tended to look only at the technology, comparing it with other technologies or with standard teaching approaches -- virtually no attention was paid to the content, to the messages themselves. Few educators asked important questions about the instructional design used, the organization of the content, or how the technology was integrated into existing systems.

More fruitful questions could have been asked about the specific capabilities of the medium and how these could be used to provide new presentation types that might be more effective or efficient. For instance, instead of investigating the differences between teaching a marine biology course as a standard lecture series or teaching it through television (the television version really being a taping of the same lecturer at class time), it would have been more beneficial to use television to do what it does best, namely to take the students into the ocean vicariously. Evaluation questions could then have centered on how much more knowledge or what intellectual skills were developed through the use of instructional television.

Evaluation and Research Issues

Relating the non-system generated data to the system-generated data constitutes a major pending evaluation issue. Such factors as contextual or environmental conditions are important to consider in assessing the videodisc

instruction; however, the procedures for relating these data to system-generated data are not well explored. There are few organizing theories or strategies for focusing on fruitful aspects of the data and ignoring less fruitful aspects. Future summative evaluations should expand the use of system-generated and other data in evaluating student outcomes. Cost-benefit analysis and case studies of use of the system should also be done in a comprehensive summative evaluation program.

A second area of pending issues involves the fine-grained analysis of student behaviors as they relate to specific student outcomes. Trying to identify whether there is a superior learning strategy in general or whether different types of students need different strategies to optimize learning is still an open question. The findings of earlier research on attribute-treatment interaction did not seem particularly promising; however, the detailed examination and control of instruction that is afforded through computer controlled videodisc may make feasible the diagnosis and individual tailoring of instruction.

A third issue involves how to use the rather difficult-to-change medium of videodisc with the very easy-to-change medium of computers. After you press the disc, how much flexibility can be planned into such a system? The degree of flexibility will determine to a large extent the role of formative evaluation in the development of video instructional systems.

Conclusion

Interactive video is really not a new tool as much as it is a powerful combination of several older instructional tools. Video can be thought of as a carrier of virtually all traditional forms of media; from texts and audio tapes to slides and films. The computer has been used in instruction for the

last two decades and has become a pervasive force recently. The combination of all media forms on one format and under computer control is what is so enticing to instructors, students and administrators alike (Wood, 1982).

In spite of this potential, very little interactive video is being used in schools and universities. Potential users are waiting for a variety of instructional materials to become available before investing in the equipment systems required for their delivery. Because there is no one equipment standard and so few videodisc players are owned by educational institutions, most publishers are waiting for circumstances to change before publishing anything on videodisc. This log jam may be broken by a particularly successful product which will entice publishers into the arena, by reduced hardware costs or by a standardization of hardware. It is also possible that a consortium of interested institutions might jointly produce and publish videodiscs and programs that are of mutual benefit, thereby overcoming the inertia at rest.

To a large degree the future of interactive video in instruction is tied to the interest of educators and sponsoring agencies in the medium, the availability of both software (especially easy to use authoring systems), courseware, and the power, ease of use and cost of the hardware. The hoped for development of inexpensive discs that can be recorded over many times and the development of longer playing time per side will both stimulate greater interest. The utilization of compact discs with smart players or with computer control may also produce exciting results.

In all of this an important role for evaluation and research exists if developers, sponsoring agencies and consumers value the input these activities can make. There is a real need for formative evaluation, summative evaluation

and research on interactive videodisc instruction. The techniques for collecting information and using it to improve instruction and further knowledge of learning theory exists to a sufficient degree to begin the task. What is needed most is the commitment of decision makers to utilize these techniques.

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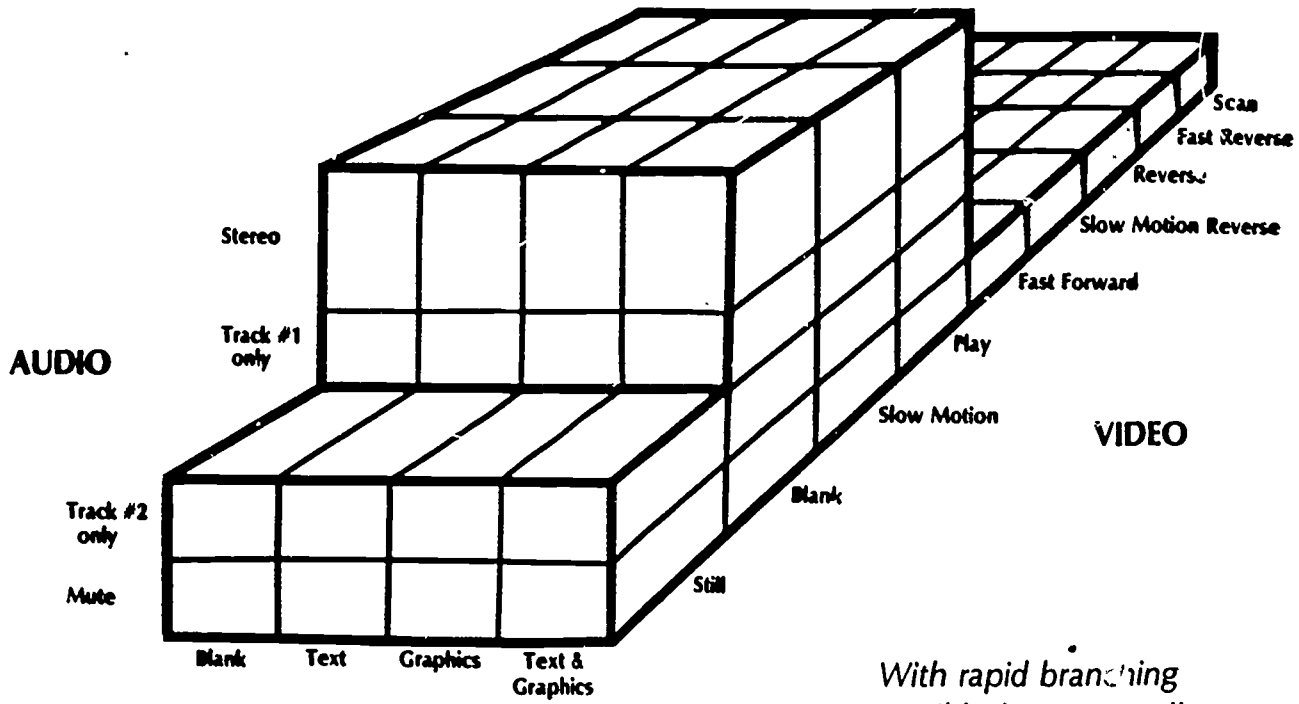
Figure Caption

Figure 1. The presentation capabilities of interactive video.



With rapid branching possible from any cell to any other cell.